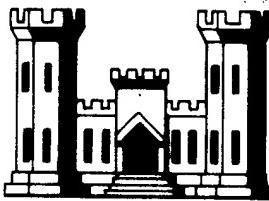


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**ENERGY ENGINEERING
ANALYSIS PROGRAM
AT
WATERVLIET ARSENAL, NY**

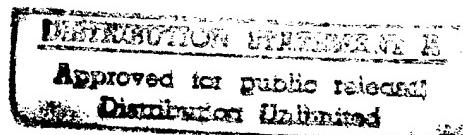


VOLUME I: EXECUTIVE SUMMARY

FINAL REPORT

19971023 098

NOVEMBER 1984



PREPARED BY

**PRC SYSTEMS SERVICES
151 CENTER STREET
CAPE CANAVERAL, FLORIDA 32920**

UNDER

NORFOLK EEAP CONTRACT DACA-65-80-C-0014



DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
P.O. BOX 9005
CHAMPAIGN, ILLINOIS 61826-9005

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EXECUTIVE SUMMARY

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1. INTRODUCTION

This is the Corrected Final Report on Increments A, B, C, D, E, and G of the Energy Engineering Analysis Program (EEAP) at Watervliet Arsenal (WVLT). This project has been conducted under the Norfolk District, Corps of Engineers Contract No. DACA 65-80-C-0014, by PRC Systems Services, Cocoa Beach, FL.

During Increments A and B, five modification projects were recommended for funding under the Energy Conservation Investment Program (ECIP). Increment G resulted in three recommended projects and Increment E determined the feasibility of a new, coal-fired central steam plant. Studies conducted during Increments C and D concluded that none of the proposed work was economically feasible under applicable guidelines.

2. EXISTING ENERGY CONSUMPTION

Actual energy consumption at WVLT was determined from electricity billings and from fuel oil delivery records. Costs were taken from contracts and service agreements that were in force at the times the various increments were undertaken.

2.1 BASEWIDE ENERGY CONSUMPTION

Using conversion factors specified in the Army Facilities Energy Plan and prices in effect during the year, the following summarizes the total energy picture for fiscal year (FY) 82.

<u>Fuel</u>	<u>Consumption</u>	<u>Dollars</u>	<u>Source Energy Units</u>
Electricity	40,581,940 kWh	\$2,241,174	470,751 MBtu
Fuel Oil No. 2	193,662 gallons	247,887	26,861 MBtu
Fuel Oil No. 6	2,462,992 gallons	<u>2,677,165</u>	<u>368,685 MBtu</u>
		\$5,166,226	866,297 MBtu

2.2 HISTORICAL FUEL CONSUMPTION

Table 1 shows the historical record of fuel consumption from FY 75 through FY 82 and projected consumption for the future. The projection assumes that energy conservation measures recommended during this contract will have been completed and that the other factors (including base mission) remain constant. Not included are the anticipated effects of Increment E recommendations since the goal of that increment is not energy conservation, but rather cost reduction and conversion to a more plentiful and secure fuel.

2.3 BUILDING TYPE: SOURCE ENERGY CONSUMPTION

Buildings were grouped into 10 categories for the purpose of this study. Using FY 80 as the base year, the building groups were modeled on the computer to determine the relative consumption of each category. The following listing summarizes the results.

<u>Group</u>	<u>Title</u>	<u>Area (ft²)</u>	<u>Consumption MBtu</u>
I	Admin, Op, Trng	212,100	31,000
II	Stor, Whse	132,000	74,500
III	Rec, Clubs, Centers	3,800	1,100
IV	Mess Halls, Eating Estab	12,400	1,200
V	Clinic	0	0
VI	Barracks, BOQ	2,900	300
VII	Stores, Banks, Lib, Chap, Mus	0	0
VIII	Svce Sta, Gar, Mot. P, Shops	1,033,600	203,400
IX	Family Housing	130,300	12,000
X	Other, Audited	102,800	32,400
-	Other, Unaudited, Fuel Oil ¹	---	64,100
-	Other, Unaudited, Electricity ²	---	390,000

¹ In addition to the unaudited buildings, this item accounts for oil to be saved because of base-initiated projects, and that used for processes.

² In addition to note 1, this item includes outdoor lighting and all pumps, fans, machines, and other equipment not subject to energy conservation measures.

Table 1. Historical Fuel Consumption

MALEWALI AIRFIELD

	Oct '74	Nov '74	Dec '74	Jan '75	Feb '75	Mar '75	Apr '75	May '75	Jun '75	Jul '75	Aug '75	Sep '75	Oct '75
Total Oil #2 GM	5087	8660	10438	10411	14392	9116	10588	6510	1146	2538	717	2858	82461
Total Oil #6 GM	20779	27088	332862	331911	294529	23999	113591	56611	30877	53768	59538	2347668	
Total Oil x 10 ³	2533	2380	2839	2672	2381	2678	2747	2749	2834	2119	2693	2661	31287

	Oct '75	Nov '75	Dec '75	Jan '76	Feb '76	Mar '76	Apr '76	May '76	Jun '76	Jul '76	Aug '76	Sep '76	Oct '76
Total Oil #2 GM	6913	1172	10958	14803	11690	9148	7986	1121	5824	190	6848	2839	88823
Total Oil #6 GM	12970	194635	362239	323317	36254	310573	186610	143411	57291	28472	45871	69312	2292775
Total Oil x 10 ³	2679	2257	2831	26464	2838	2599	2398	2844	1892	2880	2653	30980	

	Oct '76	Nov '76	Dec '76	Jan '77	Feb '77	Mar '77	Apr '77	May '77	Jun '77	Jul '77	Aug '77	Sep '77	Oct '77
Total Oil #2 GM	6223	6316	14911	16550	24019	1398	5161	5010	4975	126	2645	20197	117564
Total Oil #6 GM	216298	302413	301445	428267	331771	260558	16059	11218	62702	30952	37884	80174	2442731
Total Oil x 10 ³	2132	2817	2875	3084	2729	3022	2815	3030	3133	1995	3554	3496	35040

Table 1. Historical Fuel Consumption (cont)

WATERWELL ARSENAL

	Oct 71	Nov 71	Dec 71	Jan 72	Feb 72	Mar 72	Apr 72	MAY 72	JUN 72	JUL 72	AUG 72	SEP 72	OCT 72	NOV 72
TOTL. OIL #2 GAL	6150	12154	19195	12453	24178	10189	5865	7935	9914	168	1278	17389	129868	
TOTL. OIL #6 GAL	197459	255805	319279	393679	353385	132557	257540	131241	69106	38008	39530	411583	2559472	
WATER. FUEL X 10 ³	3249	3369	3421	3558	3015	3586	3111	3493	2680	3593	2497	3302	38927	

	Oct 73	Nov 73	Dec 73	Jan 74	Feb 74	Mar 74	Apr 74	MAY 74	JUN 74	JUL 74	AUG 74	SEP 74	OCT 74	NOV 74
TOTL. OIL #2 GAL	5193	3618	24815	21362	11504	50162	39265	3064	19952	28800	32422	43378	288125	
TOTL. OIL #6 GAL	226059	354396	285442	4144486	435591	395390	227010	83775	58779	40975	46605	51367	2649875	
WATER. FUEL X 10 ³	3127	3231	35711	3596	3747	3501	3545	3234	3160	3427	2595	3644	40980	

	Oct 74	Nov 74	Dec 74	Jan 75	Feb 75	Mar 75	Apr 75	MAY 75	JUN 75	JUL 75	AUG 75	SEP 75	OCT 75	NOV 75
TOTL. OIL #2 GAL	30535	27667	50851	29198	30239	16719	33742	31861	30035	21558	30084	355371		
TOTL. OIL #6 GAL	159398	264477	251075	356328	319979	213492	165522	91171	56034	112351	46332	41235	2068597	
WATER. FUEL X 10 ³	3015	3606	3180	3355	3646	3161	3090	3122	3523	3184	2628	3283	38875	

Table 1. Historical Fuel Consumption (cont)

	OCT '80	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
FUEL OIL #2 GAL	24188	24333	23730	50851	29200	28750	15800	28545	26670	25905	18009	24120	320,101
FUEL OIL #6 GAL	197716	263150	387607	356328	309894	325843	197621	96739	49066	22878	43247	55178	2,035,267
ELECT. KWH x 10 ³	3065	3050	3520	3353	3727	3186	3274	3316	3282	3043	2775	3371	38,960

	OCT '81	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
FUEL OIL #2 GAL	16005	17328	18918	27110	22109	35245	7809	5880	6909	7246	8917	20186	193,662
FUEL OIL #6 GAL	17509	247064	347460	505440	338873	323465	247693	78756	52563	24970	48164	51035	2,462,992
ELECT. KWH x 10 ³	3101	3131	3274	3491	3340	3340	3390	3411	3631	3520	3302	3650	40582

PROJECTED

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
FUEL OIL #2 GAL	15600	16900	18500	21600	21700	34900	7400	5500	6500	6850	8500	18966	187916
FUEL OIL #6 GAL	123395	154355	217079	315778	211714	202087	154748	49203	32839	15600	30092	31885	1,538,775
ELECT. KWH x 10 ³	3011	3041	3179	3390	3244	3244	3292	3312	3526	3418	3206	3544	39406

2.4 TYPICAL BUILDING ENERGY CONSUMPTION

Tables 2 through 9 show the consumption of energy for heating, cooling, and lighting for individual buildings (or zones of buildings). The arrangement of the buildings is by the categories listed in 2.3. (Note: Lighting energy is measured at the site; heating and cooling energy is measured at the sources.)

3. INCREMENT A - BUILDINGS AND PROCESSES

The following measures were investigated in detail during Increment A. Those in the column on the left did not meet ECIP criteria or were rejected for other reasons. Those on the right have been incorporated into one or more ECIP project packages.

Exterior Wall Insulation	Interior Wall Insulation
Domestic Hot Water (DHW) Timeclocks	Exterior Roof Insulation
DHW Temperature Setback	Interior Roof Insulation
Personnel Door Weather Stripping	Ceiling Insulation
Bay Door Weather Stripping	Underfloor Insulation
Interior Lighting	Basement Wall Insulation
Sensible Heat Economizers	Window Treating (including Weather Stripping)
Pipe/Duct Insulation	Destratification Fans
	Solar DHW
	Condenser Heat Recovery
	Exhaust Air Heat Recovery
	Outside Air Economizer

3.1 ECIP PROJECTS DEVELOPED

The following paragraphs describe the projects that have resulted from the Increment A portion of the study. The effects of the projects are summarized in section 10.

Table 2. Administration, Operations, and Training Energy Consumption

WATERVLIET ARSENAL

GROUP:	TITLE:	ADMIN. OP. TR	FLOOR AREA	HEATING CONSUMPTION			COOLING CONSUMPTION			LIGHTING CONSUMPTION		
				USE	TOTAL ANNUAL (MEGA BTU)	PEAK MONTH (MEGA BTU)	BTU PER SQ FT (X1000)	TOTAL ANNUAL (MEGA BTU)	PEAK MONTH (MEGA BTU)	BTU PER SQ FT (X1000)	TOTAL ANNUAL SITE (MEGA BTU)	BTU PER SQ FT (X1000)
P10A	5250	REPRODUCTION	287	63	54.7	10	3	1.9	19	3.6	19	3.6
P10B	3091	ADP	111	26	35.9	273	59	88.3	72	23.3	72	23.3
P10C	1790	OFFICE	111	29	62.0	0	0	0	0	1.1	2	1.1
P10D	58659	ADMIN	1016	2019	739	46.1	0	0	0	0	495	0.3
P24	11400	SECURITY	664	225	89.1	0	0	0	0	0	95	8.3
P40C	6314	ADMIN	554	147	105.2	0	0	0	0	0	91	14.4
P40D	3820	REPRODUCTION	609	119	145.0	0	0	0	0	0	14	3.7
P40E	2862	PERSONNEL	609	136	239.1	11	4	3.8	16	5.6	16	5.6
P40F	4957	ADMIN	960	207	193.7	0	0	0	0	0	79	15.9
P40H	20889	CONF ROOM	4464	996	213.7	0	0	0	0	0	170	8.5
P40I	2157	OFFICE	152	33	70.5	1	1	0.5	2	0.9	2	0.9
P40J	370	OFFICE	120	26	317.5	1	1	1	2.7	7	18.5	18.5
P40L	14716	OFFICE	3271	718	222.3	0	0	0	0	0	162	11.0
P40M	13564	OFFICE	1609	355	118.6	0	0	0	0	0	57	4.2
P40Q	6846	ADMIN	1108	240	161.8	0	0	0	0	0	0	0
P40R	3193	ADMIN	595	131	106.3	18	5	5.6	2	0.6	2	0.6
P40S	13672	ADMIN	2061	451	150.7	0	0	0	0	0	0	0
P44A	30000	GAGE BLDG	2847	621	94.9	13	1.1	343	11.4	11.4	71.3	11.4
P115B	2300	COMPUTER	568	108	247.0	164	42	56	56	24.3	0	24.3
P135B	4173	OFFICE	352	95	84.4	0	0	0	0	0	36	8.6
P145A	2000	OFFICE	273	64	136.5	0	0	0	0	0	14	7.0

Table 3. Storage and Warehouse Energy Consumption

WATERLIET ARSENAL

GROUP:	TITLE:	FLOOR AREA	USE	HEATING CONSUMPTION			COOLING CONSUMPTION			LIGHTING CONSUMPTION		
				TOTAL ANNUAL (MEGA BTU)	PEAK MONTH (MEGA BTU)	BTU PER SQ FT (x1000)	TOTAL ANNUAL (MEGA BTU)	PEAK MONTH (MEGA BTU)	BTU PER SQ FT (x1000)	TOTAL ANNUAL SITE (MEGA BTU)	BTU PER SQ FT (x1000)	
P40G	2024	21	STORAGE	10.4	0	0	0	0	0	53	26.2	
P120	93600	7711	STORAGE	82.4	0	0	0	0	0	470	5.0	
P130	20301	63863	STOREHOUSE	2250.9	0	0	0	0	0	133	4.7	
P145B	8000	531	WINE PROCESSING	66.4	0	0	0	0	0	49	6.1	

Table 4. Theaters, Clubs, and Recreation Center Energy Consumption

WATERMELT ARSENAL

Group: III (III) THEATERS, CLUBS, RECREATION CENTER

BTU/HOUR/FONT	BTU/HOUR AREA	BTU/HOUR USE	HEATING CONSUMPTION			COOLING CONSUMPTION			LIGHTING CONSUMPTION		
			TOTAL ANNUAL (MEGA BTU)	PEAK MONTH (MEGA BTU)	BTU PER SQ FT (X1000)	TOTAL ANNUAL (MEGA BTU)	PEAK MONTH (MEGA BTU)	BTU PER SQ FT (X1000)	TOTAL ANNUAL SITE (MEGA BTU)	BTU/HOUR SQ FT (X1000)	
11.000	31/32	OFF CLOTH	814	182	217.0	15	6	4.0	65	17.3	

Table 5. Mess Hall, Snack Bar, Cafeteria, and Restaurant Energy Consumption
HANWELL ARSENAL

GROUP:	ITEM:	HEATING CONSUMPTION				COOLING CONSUMPTION				LIGHTING CONSUMPTION	
		TOTAL ANNUAL USE	PEAK MONTH (MEGA BTU)	BTU PER SQ FT (x1000)	TOTAL ANNUAL (MEGA BTU)	PEAK MONTH (MEGA BTU)	BTU PER SQ FT (x1000)	TOTAL ANNUAL SITE (MEGA BTU)	BTU PER SQ FT (x1000)		
IV	MESS HALL, SNACK BAR, CAFETERIA, RESTAURANT	11394 965	145 220	164 51	65.4 236.3	18 29	5 7	1.6 30.1	34 20	3.0	20.7
V21000 P400	RESTAURANT PX										

Table 6. Barracks and BOQ Energy Consumption

WATERJET AUSENAL

Group: VI Unit: BARRACKS, BOQ

Group: VI	Unit:	BARRACKS, BOQ	HEATING CONSUMPTION			COOKING CONSUMPTION			LIGHTING CONSUMPTION		
			MMB/THD	MMB/THD	MMB/THD	MMB/THD	MMB/THD	MMB/THD	MMB/THD	MMB/THD	MMB/THD
P2100	1528	800	173	39	113.2	1	2	2.6	0	0	0
P2200	1406	800	140	30	99.6		0	0.7			0

Table 7. Gas Station, Garage, Motor Pool, and Shops Energy Consumption

WATERMELT ARSENAL

GROUP: VIII: 11111: GAS STATION, GARAGE, MOTOR POOL, SHOPS

BUDGET AREA	USE	HEATING CONSUMPTION			COOLING CONSUMPTION			LIGHTING CONSUMPTION		
		TOTAL ANNUAL (MIGA BTU)		BTU PER SQ FT (X1000)	TOTAL ANNUAL (MIGA BTU)		BTU PER SQ FT (X1000)	TOTAL ANNUAL SITE (MIGA BTU)		BTU PER SQ FT (X1000)
		PEAK MONTH (MEGA BTU)	BTU PER SQ FT (X1000)	PEAK MONTH (MIGA BTU)	BTU PER SQ FT (X1000)	PEAK MONTH (MIGA BTU)	BTU PER SQ FT (X1000)	PEAK MONTH (MIGA BTU)	BTU PER SQ FT (X1000)	PEAK MONTH (MIGA BTU)
P15	22990	4110	940	179.6	0	0	0	108	4.7	
P20A	96000	19027	4531	198.2	0	0	0	1046	10.9	
P270011	8152	724	163	66.7	0	0	0	57	6.8	
P23	10220	2251	566	120.2	0	0	0	235	12.6	
P2360A	61200	1591	360	26.0	0	0	0	1087	30.8	
P2340	61200	1539	352	25.5	0	0	0	1179	19.3	
P2380C	61200	15296	3392	249.9	245	94	4.0	1423	23.3	
P15A	169053	12446	2905	7.3	0	0	0	2423	14.3	
P40A	1960	202	59	100.8	30	9	19.2	2	1.3	
P40C	2040	375	78	103.8	29	9	14.2	43	21.1	
P40C	224925	24697	6129	109.8	0	0	0	2985	13.3	
P410	119340	16016	4094	134.2	0	0	0	1447	12.1	
P425	116645	59293	13916	317.7	0	0	0	2418	13.0	

Table 8. Family Housing Energy Consumption
UNIVERSITY AUSTRIAN

Group : IX	1000 : FAMILY HOUSING	WELLING CONSUMPTION			COOKING CONSUMPTION			LIGHTING CONSUMPTION		
		BUDGET	USE	TOTAL ANNUAL (MEGA BTU)	PEAK MONTH (MEGA BTU)	BTU PER SQ FT (X1000)	TOTAL ANNUAL (MEGA BTU)	PEAK MONTH (MEGA BTU)	BTU PER SQ FT (X1000)	TOTAL ANNUAL SITE (MEGA BTU)
P3	9740	SINGLE	609	145	62.5	0	0	0	0	30
P6	12970	DUPLEX	934	216	61.6	0	0	0	0	120
P8	11173	DUPLEX	737	163	66.0	0	0	0	0	84
P9	2260	DUPLEX	203	69	125.2	0	0	0	0	32
P19	9200	MULTI	603	140	65.5	0	0	0	0	69
P40A	2775	DUPLEX	1033	214	372.3	0	0	0	0	21
P40B	3964	DUPLEX	974	205	245.7	0	0	0	0	21
P40C	2460	DUPLEX	166	42	67.5	0	0	0	0	18
P40D	2016	SINGLE	137	30	60.0	0	0	0	0	15
P40E	9151	MULTI	396	98	43.3	0	0	0	0	68
P41A*	13793	MULTI	602	149	43.6	0	0	0	0	103
P49G	2730	SINGLE	254	58	93.0	0	0	0	0	21
P49H	1008	DUPLEX	239	61	62.8	0	0	0	0	28

* House as other similar buildings

Table 9. Other Energy Consumption
WATERLOO ARSENAL

Group:	X	Title:	Other	HEATING CONSUMPTION				COOLING CONSUMPTION				LIGHTING CONSUMPTION			
				WING/TOWER	BLDG AREA	TOTAL ANNUAL (MIGA Btu)	PEAK MONTH (MIGA Btu)	BTU PER SQ FT (x1000)	TOTAL ANNUAL (MIGA Btu)	PEAK MONTH (MIGA Btu)	BTU PER SQ FT (x1000)	TOTAL ANNUAL SITE (MIGA Btu)	BTU PER SQ FT (x1000)	TOTAL ANNUAL SITE (MIGA Btu)	BTU PER SQ FT (x1000)
P200	9600	OFFICE	960	250	10.0	0	0	123.6	216	22.5	22.5	131	476.4	476.4	1.3
P150	275	OFFICE	397	99	1443.6	34	12	0	1	1	1	1	3.1	3.1	3.1
P40K	700	CLASSROOM	524	106	671.8	1	0	1	1	1	1	2	649	649	8.4
P40W	649	INTRODUCTION	220	48	351.3	2	1	60	1.5	60	1.5	649	649	649	8.4
P115A	77000	WEAPONS DEV	16442	3462	211.6	114	23	4.5	4.5	23	4.5	115	115	115	8.3
P124	13776	1 AB	1051	477	134.6	62	0	0	0	0	0	0	0	0	0
		1 AB													

3.1.1 ARCHITECTURAL/STRUCTURAL/DESTRATIFICATION MODIFICATIONS. Work will consist of the following modifications to achieve improved energy conservation:

a. Wall Insulation.

- (1) R5 spray cellulose in buildings P25, P145
R7 spray cellulose in buildings P25, P130
R9 spray cellulose in buildings P25, P135

- (2) R9 F/G batts in building P15
R13 F/G batts in building P135
R15 F/G batts in buildings P10, P22, P125
R17 F/G batts in building P41
R19 F/G batts in buildings P10, P22, P40, P41, P44

b. Ceiling (Roof) Insulation.

- (1) R15 blown-in F/G in building P10
R17 blown-in F/G in building P115

- (2) R9 lay-in F/G batts in building P44
R13 lay-in F/G batts in building P44

- (3) R19 exterior IRMA-type roof system on building P20

- (4) R19 exterior insulation and new shingles on building P110

c. Floor/Basement Insulation.

- (1) R9 spray cellulose on basement walls in building P10

- (2) R9 F/G batts and furring on basement walls in building P23

- (3) R9 F/G batts and mesh under floor of building P22

d. Steam Pipe Insulation. R4 F/G in building P41

e. Window Treatment.

- (1) Double glazing on building P40
- (2) R14 insulating curtains on buildings P10, P22, P23, P24, P25, P40, P41, P44, P135
- (3) R19 dryvit-type panels on windows in buildings P120, P35, and P124
- (4) Translucent sandwich panels on buildings P125 and P130
- (5) R19 dryvit-type panels over 80 percent of translucent area, R11 translucent sandwich panels over 16 percent, and double pane glass over 4 percent of the existing translucent areas of building P135

f. Destratification. Fans in buildings P20, P110, P125, P35

NOTE

The terms dryvit, IRMA, fiberglass (or F/G) as used herein are intended as descriptive terms only. They are used for brevity and clarity to indicate acceptable types of modifications. Any equivalent product may be utilized.

3.1.2 SOLAR DHW HEATERS IN FAMILY HOUSING. Work will consist of installation of solar DHW heaters and appropriate plumbing and instrumentation in Rotterdam family housing. In addition, for buildings P471 and P475, a small weatherproof cover will be constructed to house the new hot water tank.

3.1.3 HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC) SYSTEMS MODIFICATIONS.

- a. Building 25 - Exhaust Air Heat Recovery. Work will consist of modifications to the existing first and second floor outside air intake and exhaust air systems to provide for a glycol pumparound system as follows:

- (1) Install air-to-glycol coils in north and south penthouse air intake
 - (2) Install air-to-glycol heat recovery coils in the north and south general and toilet exhausts and the north elevator exhaust
 - (3) Install a pump/control center and assorted glycol piping with insulation and suitable controls
- b. Building 44 - Reduce Outside Air Intake. Work will consist of system modifications to HV-1 heating and ventilating system as follows:
- (1) Modify outside air intake duct for modulating dampers and air handler plenum to accommodate a return air duct with dampers
 - (2) Install a return air duct system from the zone to HV-1
 - (3) Modify controls and provide for damper modulation to control outside and return air in inverse proportions
 - (4) Provide exhaust fan control modifications for minimum, medium, and maximum ventilation modes to operate in conjunction with HV-1 damper controls.

4. INCREMENT B - UTILITIES, DISTRIBUTION SYSTEMS, AND ENERGY MONITORING AND CONTROL SYSTEM (EMCS)

The following measures were studied under Increment B:

- o Exterior lighting improvements
- o Steam/condensate system improvements
- o Electricity distribution system improvements
- o EMCS expansion

4.1 ECIP PROJECTS DEVELOPED

This paragraph describes the projects that resulted from the Increment B portion of the study. The effects of the projects are summarized in 10.

4.1.1 MODIFICATIONS FOR EMCS. Buildings at WVLT are to be modified to achieve improved energy conservation. Install EMCS to control and minimize energy consumption. Useful management data will be reported to reduce labor requirements and report malfunctions as well as minimizing energy consumption during building nonuse hours.

Controls and sensors will be installed in buildings 10, 15, 20, 21, 23, 24, 25, 35, 40, 44, 110, 115, 120, 124, 125, 130, 135, and 136.

4.1.2 ELECTRICAL DISTRIBUTION SYSTEM MODIFICATIONS. Project consists of reducing the capacity of transformers by moving several existing transformers to different substations and by installing new transformers where requirements indicate.

5. INCREMENT C - RENEWABLE ENERGY SOURCES: SOLAR AND BIOMASS

The feasibility of utilizing solar energy to supplement DHW heating, space heating, and a combination of water and space heating was analyzed during Increment C. No project in either the sample support building or in the sample family housing building proved acceptable under Increment C guidelines.

In the biomass portion of Increment C, the present economic viability of wood chips as a substitute fuel was determined. However, because of the uncertainty of supply and the potential volatility of the price, conversion to biomass as the primary fuel was not recommended. There are no other potential sources of renewable energy at WVLT.

6. INCREMENT D - COGENERATION

Four different steam pressure/temperature situations were analyzed in order to determine the feasibility of electric cogeneration. In each case, a superheater was required and outlet steam conditions had to be equivalent to current heating

system supply conditions. In none of the cases was the life cycle cost as low as that of the status quo. Therefore, no projects are recommended.

7. INCREMENT E - CENTRAL BOILER PLANT PROJECTS

Increment E resulted in the recommendation that a new, coal-fired, fluidized bed boiler plant be constructed near the site of the existing plant. Life cycle cost analysis (per applicable guidelines) clearly indicated the economic feasibility of coal firing versus oil.

8. INCREMENT F - FACILITIES ENGINEER CONSERVATION MEASURES

No Increment F study was authorized under this contract.

9. INCREMENT G - NONQUALIFIED INCREMENTS A AND B PROJECTS

Several projects that were originally considered under Increment A were re-analyzed under this increment. Those projects that are acceptable under Increment G criteria are described in the following paragraph. The effects of the projects are summarized in 10. One additional project, to combine the chilled water systems in buildings 115 and 120, was rejected again.

9.1 INCREMENT G PROJECTS DEVELOPED

9.1.1 WEATHERIZATION MODIFICATIONS. Work will consist of the following modifications to improve energy conservation:

- a. Wall Insulation. R7 interior spray in buildings P110, P120, P124
- b. Lighting Modification. Replace fluorescent with high-pressure sodium in buildings 15 and 130
- c. Window Area Modification.
 - (1) Replace deteriorated windows with same size double-glazed windows in building P10

- (2) Replace deteriorated windows with double-glaze windows to fill 40 percent of window opening and fill 60 percent with insulated 6-in stud wall in building P40
- (3) Cover deteriorated window area with 80 percent translucent sandwich panels and 20 percent double-glazed operable windows in building P110

9.1.2 WEATHERIZATION MODIFICATIONS IN FAMILY HOUSING. Work will consist of the following modifications to improve energy conservation:

- a. Wall Insulation.
 - (1) R15 interior batt in building P21
 - (2) R17 interior batt in building P490
 - (3) R19 interior batt in building P22
- b. Basement Wall Insulation. R11 spray cellulose in building P490
- c. Insulating curtains in buildings P21, P22, P40, P460, P463, P490, P492
- d. Shower flow restrictors in buildings P460, P463, P471, P472, P473, P474, P475, P490, P492
- e. Automatic setback thermostats in buildings P460, P463, P470, P471, P472, P473, P474, P475

9.1.3 HVAC MODIFICATIONS: RETROFIT ELECTROSTATIC PRECIPITATORS. This project for building P125, Weld Shop, consists of modifications to the two existing exhaust systems to retrofit electrostatic precipitators for removal of contaminants and recirculation of a major percentage of the heated room air.

- a. Remove existing fan assemblies
- b. Install new fan/precipitator units
- c. Modify ducts and install new recirculated air supply ducts
- d. Install new modulating dampers in the outside air intake, exhaust, and recirculated air ducts with appropriate thermostatic controls

10. ENERGY PLAN

In FY 82, WVLT consumed 866,297 MBtu's of energy at a cost of over \$5 million. Implementation of all recommended projects except Increment E would reduce this consumption to 713,513 Btu's, which would cost less than \$4 million at comparable prices. Table 10 summarizes the recommended EEAP projects.

10.1 ENERGY USAGE PER SQUARE FOOT

The total area of buildings at WVLT is 1.7 million ft². On a gross basis, the consumptions in Btu's in FY 82 and after implementation of recommended projects are:

	<u>FY 82</u>	<u>Future</u>	<u>Δ</u>
Electricity	276,912 Btu/ft ²	268,888 Btu/ft ²	8,024 Btu/ft ²
Fuel Oil No. 2	26,861 Btu/ft ²	26,064 Btu/ft ²	797 Btu/ft ²
Fuel Oil No. 6	<u>368,685 Btu/ft²</u>	<u>230,339 Btu/ft²</u>	<u>138,346 Btu/ft²</u>
	672,458 Btu/ft ²	525,291 Btu/ft ²	147,167 Btu/ft ²

This represents an overall reduction of almost 22 percent in total energy consumption.

Table 10. EEAP Project Summary

<u>Project</u>	<u>Increment</u>	DD 1391 Information						Energy Savings			
		Project Year	CWE \$1,000	E/C	B/C	P/B	F0 #2	Gallons F0 #6	kWh Electricity	Total MBtu	
Architectural/Structural/ Destratification Modifications	A	1984	5,310	13.8	2.7	9.1	0	504,603	-183,621	73,404	
Solar Assisted DHW	A	1984	383	2.4	0.4	18.9	2,588	0	48,621	923	
HVAC Systems Mods	A	1984	346	21.3	4.1	6.2	0	50,812	-20,259	7,371	
Install EMCS	B	1984	735	69.7	2.1	7.3	0	286,659	714,483	51,198	
Elec Dist Syst Mods	B	1984	304	20.1	2.7	7.9	0	0	525,603	6,097	
Weatherization Modifications	G	1984	1,728	6.6	1.7	14.9	0	72,964	34,914	11,327	
HVAC Modification	G	1984	123	9.5	1.8	14.8	0	7,950	-1,552	1,172	
Weatherization for Family Housing	G	1984	42	31.0	4.0	4.0	<u>3,158</u>	<u>1,229</u>	<u>57,845</u>	<u>1,293</u>	
Totals			5,746	924,217	1,176,034	152,785					